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Bi-Monthly Progress Report

Period: July 1 to August 31, 1973

A. Title of Investigation: A Study of the Utilization of ERTS-1 Data from the Wabash River Basin

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C. Problems

The chief problem encountered by the applications projects continues to be the difficulty of locating and identifying small areas in computer reproduced ERTS imagery. Geometric correction processing has helped significantly and an improvement in this process is described below.

D. Accomplishments

Crop Species Identification: Analysis of ERTS data collected during the summer and early fall, 1972 over Crop Reporting District No. 9 in Southeast Missouri has been nearly completed. This has been a cooperative effort between SRS/USDA and LARS. SRS supplied the ground truth data, assisted in the analysis of the MSS data and with LARS is evaluating the results. LARS geometrically corrected and overlaid the ERTS MSS data, located the ground truth segments and fields in the data, worked with SRS in analyzing the MSS data, and is assisting in evaluation of the results. A major accomplishment of this particular investigation has been the use of automatic data processing techniques by SRS. Cooperative work is continuing between SRS and LARS.

A. Procedures

Twenty-nine area segments were located in two ERTS frames which covered Crop Reporting District No. 9 in Southeast Missouri. Data from ERTS passes on August 26, September 14, and October 2, 1972 were overlaid and geometrically corrected. Geometric correction greatly facilitated locating segments and fields. Temporal overlay alleviated the necessity of locating fields in three different data sets as well as permitted a test of the usefulness of temporal data in the classification.

Segments were located in the August ERTS data which had been deskewed and scaled to 1/24,000 scale by overlaying computer printouts onto 1/24,000 scale maps on which the segments had been drawn. The segments were then clustered and coordinates of the individual fields found on a non-supervised (cluster) classification map.

(E73-11082) A STUDY OF THE UTILIZATION OF ERTS-1 DATA FROM THE WABASH RIVER BASIN Bimonthly Progress Report, 1 Jul. - 31 Aug. 1973 (Purdue Univ.) 5 p HC $3.00 CSCL 08H G3/13
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Statistics for the classes, cotton, soybeans, corn, harvested wheat, grass, and miscellaneous were obtained and the data classified. Thus far in the analysis nearly all the available crop fields have been used as training fields. While training field classification performance is generally higher than test field performance, a major objective is to determine what is the highest level of classification performance which can be expected. The use of training field performance is probably the best indicator of this. Comparisons of discriminant functions with and without weights or prior probabilities were made. The weights were the number of acres of each crop found in the segments.

B. Results

Preliminary results, considering only training field performance, indicates that it will likely be difficult to identify cotton and soybeans during the growth stages considered in this investigation. There was some confusion between cotton and soybeans as well between these two crops and other cover types present (Table 1).

Comparison of results in Tables 1 and 2 show that use of prior probability information in the discriminant function improved the performance considerably. Such information is readily available from historic data such as earlier surveys.

1: Classification performance with unequal prior probabilities.*

Class	No. Points	No. Points Classified As Cotton	Soybeans	"Other"	Percent Correct
Cotton	927	739	137	51	79.7
Soybeans	852	99	612	141	71.8
"Other"	438	68	117	253	57.8
	2217				

Overall Performance $\frac{739+612+253}{2217} = 72.4\%$

2: Classification performance assuming equal prior probabilitie

Class	No. Points	No. Points Classified As Cotton	Soybeans	"Other"	Percent Correct
Cotton	927	689	83	155	74.3
Soybeans	852	101	338	413	39.7
"Other"	438	52	32	352	80.8
	2217				

Overall Performance $\frac{689+338+354}{2217} = 62.3\%$

* Results in Tables 1 and 2 are for the multitemporal case.

August 26, 1972	Bands 4, 5, 7
September 14, 1972	Bands 5, 7,
October 2, 1972	Bands 4, 5, 6, 7

The value of multitemporal information in the classification of cotton and soybeans is shown in Table 3. For cotton, performance was improved 7 to 19 percent by using all bands from three dates compared to each of the dates individually. For soybeans, the highest performance was for the August 26 ERTS pass.

3: Comparison of unitemporal and multitemporal classification of cotton and soybeans.

Crop	Classification Performance (Percent Correct)			
	August 26[1/]	September 14[2/]	October 2[3/]	All Dates
Cotton	60.6	69.7	73.2	79.7
Soybeans	86.0	67.6	62.4	71.8

1/ Bands 4, 5, and 7

2/ Bands 5 and 7

3/ Bands 4, 5, 6, and 7

Mapping of Soil Associations: Work proceeds on the improvement of soil map and ERTS data overlay techniques for analysis and mapping of soil associations from ERTS data. The technique reported in the June 1973 Type II report used system corrected 70 mm imagery. Work currently in progress will use geometrically corrected CCT data reproduced on the LARS Digital Display System. This approach will ultimately enable digital analysis to be performed on the same areas studied in the image and map overlay.

Atmospheric Modeling: The selection of atmospheric parameters for the radiation model is now completed. Gaseous absorption coefficients and aerosol optical thickness values appropriate for the four MSS channels have been chosen. The next phase of the work will involve testing the model's capabilities on ERTS data. A data set obtained on August 9, 1972 over Northeastern Illinois will be used for the first attempt. These data have already been analyzed by LARS personnel for crop types.

Reformatting and Overlay: Reformatting and maintenance of the ERTS-1 CCT data for the LARS data bank proceeded without problem during the period. Overlay of sequential frames of ERTS data was supplied as a data support service as described in earlier reports.

A useful advancement in all digital geometric correction of ERTS data was achieved during the period. Previous developments reported in the June 1973 Type II report have enabled rotation, rescaling and deskewing operations to be performed such that images generated on LARS output devices would have a specific scale factor and be North-oriented. This correction is approximate and produces results which can be in error by several hundred meters over a distance of several kilometers. Correction of the image geometry to an accuracy of one sample requires the measurement of matching points in a reference and in the data. These ground control points are then used to recorrect the image geometry.

An experimental precision correction was carried out in conjunction with a project funded by the U. S. Geological Survey and the results were excellent as determined by visual inspection. CCT data from ERTS frame 1003-18175 was approximately corrected for scale, rotation, and skew using previously discussed techniques. The data was scaled so that when printed in pictorial form on a computer line printer the scale is approximately 1"≈24000". Easily identifiable features such as schoolyards and parks were located on 1:24000 topographic maps by USGS personnel. The corresponding areas were located in the ERTS data printouts. The map used was USGS 7 1/2 minute quad-San Jose West. Thirty-six matching points were found covering a 10 x 7 1/2 mile area. The coordinate system used for the map points was the UTM system. Vertical and horizontal coordinates were measured to the nearest 10 meters and punched in standard LARS checkpoint format on cards along with the line and column coordinates for the same point in the data. These coordinates were processed by a geometric distortion function estimation program and parameters were computed to correct the remaining geometric error in the data for the given area. The data was then re-geometrically corrected to produce the final version. The results were overlayed on the topographic map to inspect the accuracy of the fit. No error could be visually observed over the 7 1/2 x 10 mile area although it is extremely difficult to estimate locations to better than one or two pixels in ERTS-1 data. Further work will be done to develop a procedure for making all digital precision geometric corrections when necessary.

E. Significant Results

The crop identifications effort produced results indicating difficulty in discriminating cotton and soybeans in the Missouri area in the late August, September - October period. The use of

prior probabilities in classification was shown to increase performance significantly. The use of temporal data was observed to improve classification accuracy for September 14 and October 2 data but not for August 26 data. Geometric correction and temporal overlay processing of the ERTS data proved to be very valuable for field location and relationship of fields from one time to another. Precision geometric correction of ERTS data was achieved using manually derived ground control checkpoints.

F. No Publications were Submitted

G. Plans for Next Period

During the next period the crop identification project will further evaluate the use of multitemporal data and test other analysis procedures. Test field performance will be obtained. Results will be evaluated against several criteria for their value in estimating crop acreages. Progress in the other project areas will be reported in subsequent reports.

H. Other

No changes in standing order forms were made and no image descriptor forms were completed.